Plant Development and Environmental Responses

Code: 43868
ECTS Credits: 6

<table>
<thead>
<tr>
<th>Degree</th>
<th>Type</th>
<th>Year</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>4316231 Plant Biology, Genomics and Biotechnology</td>
<td>OT</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Contact**

Name: Teresa Altabella Artigas

Email: Desconegut

**Teachers**

Mercè Llugany Ollé

**External teachers**

Ana Monserrat Martín Hernández
Elena Monte
Ignacio Rubio Somoza
Juan José López Moya
Maria Coca
Nuria Sanchez Coll
Teresa Altabella (taltabella@ub.edu)

**Prerequisites**

Basic knowledge of Plant Physiology, Genetics and Molecular Biology.

**Objectives and Contextualisation**

To transmit the knowledge necessary to understand the main processes of plant development, how these processes are organized, coordinated and adapted to different environmental conditions, including responses to stress. To know the molecular mechanisms and genetic networks regulating all the mentioned processes.

**Competences**

- Apply knowledge of functional mechanisms of various different organizational levels in plants to the characterization of growth and development processes of the whole plant organism.
- Apply knowledge of plant molecular genetics in different scientific and industrial areas.
- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
- Conceive, design, manage and develop a scientific, technical or industrial project in Biology and Biotechnology of plants and fungi, and be able to interpret and extract knowledge of the same.
• Continue the learning process, to a large extent autonomously.
• Develop critical reasoning in the area of study and in relation to the scientific and business environment.
• Identify and use Bio-Computer Science tools to be applied to the genetic, evolutionary and functional study of plants.
• Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
• Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
• Synthesize, and analyze alternatives and debate critically.
• Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
• Use and manage bibliographical information and computer resources in the area of study.
• Use scientific terminology to argue the results of research and present them in English both orally and in writing in an international environment.

Learning Outcomes

1. "Understand the molecular mechanisms and the ""logic"" of the genetic networks that regulate development in different environmental conditions."
2. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
3. Continue the learning process, to a large extent autonomously.
4. Design and implement a project to obtain plants that are more tolerant to different types of biotic and/or abiotic stress.
5. Design and implement a project to obtain plants that have adaptive advantages in their natural habitat.
6. Develop critical reasoning in the area of study and in relation to the scientific and business environment.
7. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
8. Know and apply appropriate tools to dissect the genetic networks that regulate plant development and the interactions between them.
9. Know and apply the methodology that is best suited to the genetic and molecular study of the different processes in plant development.
10. Know and apply the methodology that is best suited to the study of signalling routes and hormone interactions in the different stages of plant development and in plants' responses to biotic and abiotic stress.
11. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
12. Synthesize, and analyze alternatives and debate critically.
13. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
14. Use and manage bibliographical information and computer resources in the area of study.
15. Use scientific terminology to argue the results of research and present them in English both orally and in writing in an international environment.

Content

THEORY:

1. PLANT DEVELOPMENT


2. ABIOTIC STRESS

3. BIOTIC INTERACTIONS


Methodology

Theoretical lectures: Within this module, master or expository lectures represent the main activity to be performed in the classroom and allow basic concepts to be transmitted to students in a relatively short time. They will be complemented with Powerpoint presentations, thus the methodology is mainly based on verbal communication, accompanied by visual schemes. Teacher's direct questions to students during the class are indicative of the student's degree of follow-up. Bibliographical references and other sources of information are given to foster self-study.

Seminars: They are work sessions, based on work proposed by the teachers that the students will work autonomously. The main purpose of the seminars in this subject is to promote the knowledge of the general and transversal competences of the students. The teaching methodology is based on the exposition and discussion of a scientific article in the classroom. Students have to search for and select an adequate article according to the quality criteria explained by the teacher.

Laboratory practices: Some of the topics covered in the theory class are visualized through laboratory testing. The student will get familiar with protocols and basic techniques of a Plant Physiology Lab.

Tutoring: In tutorials in groups or individually, the professor tries to help the students to solve their doubts about the concepts of the subject and guide them in their studies.

Activities

<table>
<thead>
<tr>
<th>Title</th>
<th>Hours</th>
<th>ECTS</th>
<th>Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory practices</td>
<td>3.5</td>
<td>0.14</td>
<td>8, 9, 10, 6, 2, 3</td>
</tr>
<tr>
<td>Lectures</td>
<td>30</td>
<td>1.2</td>
<td>1, 8, 9, 10, 7, 5, 4, 13, 14, 15</td>
</tr>
<tr>
<td>Seminars</td>
<td>3</td>
<td>0.12</td>
<td>6, 2, 3, 12, 14, 15</td>
</tr>
<tr>
<td>Tutorials</td>
<td>7</td>
<td>0.28</td>
<td>6, 7, 11, 2, 12</td>
</tr>
<tr>
<td>Personal study</td>
<td>90</td>
<td>3.6</td>
<td>7, 11, 3, 14</td>
</tr>
<tr>
<td>Preparation of seminars</td>
<td>12</td>
<td>0.48</td>
<td>6, 2, 3, 12, 13, 14, 15</td>
</tr>
</tbody>
</table>
**Assessment**

The evaluation is based on the following items:

Written exams: to evaluate the contents of the lectures. There will be two eliminatory tests corresponding to two equitable parts of the program. To be able to pass the subject, a minimum grade of 5 must be obtained in each of these parts. The weight of each partial exam in the theory note is 50%. The weight of the theory mark in the final grade is 60%.

Seminars: Participation in the seminars and the quality of the works presented will account for 30% of the final mark.

Assistance, attitude and participation will be valued by a 10% maximum.

**Assessment Activities**

<table>
<thead>
<tr>
<th>Title</th>
<th>Weighting</th>
<th>Hours</th>
<th>ECTS</th>
<th>Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistance and participation</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>6, 11, 2, 12, 15</td>
</tr>
<tr>
<td>Seminar evaluation</td>
<td>25</td>
<td>1.5</td>
<td>0.06</td>
<td>1, 7, 11, 2, 3, 12, 13, 14, 15</td>
</tr>
<tr>
<td>Written exams</td>
<td>55</td>
<td>3</td>
<td>0.12</td>
<td>1, 8, 9, 10, 6, 11, 2, 5, 4</td>
</tr>
</tbody>
</table>

**Bibliography**

Plant hormones: physiology, biochemistry and molecular biology (book)


Hormonal Interactions in the Regulation of Plant Development.


Seed Dormancy and Germination

Bentsink L. and Koornneef M. 2008 *THE ARABIDOPSIS BOOK* 6: e0119. [https://doi.org/10.1199/tab.0119](https://doi.org/10.1199/tab.0119)

Two Faces of One Seed: Hormonal Regulation of Dormancy and Germination.


PIFs: systems integrators in plant development

Leivar and Monte. 2014. *PLANT CELL*, 26: 56-78

Molecular Control of Grass Inflorescence Development

Zhang and Yuan. 2014. *ANNU. REV. PLANT BIOL*. 65:553-78

Leaf Development


Photomorphogenesis

Arsovski et al. 2012 *THE ARABIDOPSIS BOOK* 10: e0147. [https://doi.org/10.1199/tab.0147](https://doi.org/10.1199/tab.0147)
Shade Avoidance

Flower Development

Molecular plant-microbe interactions (book)
Plant immunity: towards an integrated view of plant-pathogen interactions.

Centrality of host cell death in plant-microbe interactions.
Dying two deaths - programmed cell death regulation in development and disease.

The Top 10 oomycete pathogens in molecular plant pathology.
The Top 10 fungal pathogens in molecular plant pathology.
Top 10 plant pathogenic bacteria in molecular plant pathology.
Top 10 plant viruses in molecular plant pathology.
Top 10 plant-parasitic nematodes in molecular plant pathology.
How rhizobial symbionts invade plants: the Sinorhizobium-Medicago model.
Mechanisms underlying beneficial plant-fungus interactions in mycorrhizal symbiosis.
Mechanisms to Mitigate the Trade-Off between Growth and Defense.
Disease resistance or growth: the role of plant hormones in balancing immune responses and fitness costs.